ESTIMATION OF SEDIMENT YIELD FROM KUANTAN RIVER BASIN USING MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE)

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Air dalam bentuk hujan adalah punca utama yang mempercepatkan kadar hakisan tanah di tanah yang menjadi hasil sedimen. Tujuan kajian ini adalah untuk menganggarkan hasil sedimen dari Lembangan Sungai Kuantan dengan menggunakan model matematik Modified Universal Soil Loss Equation (MUSLE). Satu siri data dikumpulkan untuk mendapatkan parameter kelantangan larian (V), pelepasan puncak (Qp), faktor kelimasan tanah (K). Perisian ArcGIS digunakan untuk mendapatkan faktor topografi (LS), faktor amalan kawalan hakisan (P) dan faktor pengurusan penutup (C). Dengan semua data yang berkaitan, hasil sedimen dari lembah sub-sungai Kuantan dikira menggunakan persamaan model MUSLE matematik. Oleh itu, hasil sedimen dari Lembangan Sungai Kuantan pada tahun 2015 dan 2035 boleh dibandingkan. Lebih-lebih lagi, sub-basin yang mengandungi jumlah sedimen tertinggi dan paling rendah dalam kedua-dua tahun boleh ditentukan. Sub-basin Riau mencapai tahap tertinggi dalam kadar sedimen dalam kedua-dua tahun 2015 dan 2035 iaitu 32750.52 tons/yr dan 2764.09 tons/yr manakala sub-basin Sungai Isap mempunyai bilangan sedimen yang paling rendah dalam kedua-dua tahun iaitu 1.5653 tons/yr dan 0.5177 tons/yr.

ABSTRACT

The water in the form of rain is the main cause which accelerates the soil erosion rate on the ground which become sediment yield. The purpose of this study is to estimate the sediment yield from Kuantan river basin using the Modified Universal Soil Loss Equation (MUSLE) mathematical model. A series of data were collected to get the parameters of runoff volume (V), peak discharge (Q_p), soil erodibility factor (K). ArcGIS software was utilized to obtain the topographic factor (LS), erosion control practice factor (P) and cover management factor (C). With all the relevant data, the sediment yield from Kuantan sub-river basin was computed using the MUSLE mathematical model equation. Sediment yield from Kuantan River Basin in year 2015 and 2035 was compared. And he sub-basins that contain highest and lowest amount of sediment yield in both years determined. Riau sub-basin has the highest amount of sediment yield in year 2015 and 2035 with the amount of 32750.24 tons/yr and 2764.09 tons/yr respectively. Conversely, Sungai Isap sub-basin has lowest amount of sediment yield in both years with the amount of 1.5653 tons/yr in year 2015 and 0.5177 tons/yr in year 2035.

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LIST OF SYMBOLS

λ	Sheet Flow Path Length (m or feet)
φ	72.6 foot for Imperial Units or 22.13m for SI
°C	Unit temperature in degree Celsius
Q_p	Peak Flow in metre cube per second
V	Runoff Volume in metre cube
Y	Sediment Yield in tons per year

LIST OF ABBREVATIONS

K	Soil Erodibility Factor
LS	Slope Length and Slope Steepness Factor
C	Cover Management Factor
P	Erosion Control Practices Factor
USLE	Universal Soil Loss Equation
MUSLE	Modified Universal Soil Loss Equation
MSMA	Manual Saliran Mesra Alam
JUPEM	Jabatan Ukuran dan Pemetaan Malaysia
LULC	Landuse and Landcover

CHAPTER 1

INTRODUCTION

1.1 Background

Sediment yield of a sub-basin of a river is often caused by soil erosion which usually occurred naturally. Factors affecting the soil erosion can be categorized into human and natural prompted. Precipitation and steepness of slope comprise natural factors for the most part, while human causes consists of development or activities related to agriculture, mining and constructions. Such activities usually remove the protective vegetation concealment, resulting in accelerated erosion by both water and wind. Factors that occurred naturally affect the upper soil layer more often as compared to human prompted factors. Both contribute a significant amount of soil loss due to water erosion.

Soil erosion comes from water in the form of rain and runoff. Particles of the soil especially fine sand and silt are broken off and being dispersed when there is a rain. This damage of soil increases with heavy rain and thunderstorms. Runoff can carry these particles to rivers, oceans, streams or lakes. Runoff occurs when water drifts down a slope, or surface, and is not absorbed into the soil. Runoff increases when soil is over hydrated, as the soil is unable to absorb any more water. This runoff can carry more rich topsoil. Soil erosion removes valuable top soil which is the most productive part of the soil profile for agricultural purposes. The loss of this top soil results in lower yields and higher production costs.

While soil itself can resist erosion, this can be influenced by a variety of factors. Several things such as amounts of animal and plant matter which decomposed in the soil, the ability for water to pass through the soil, and good soil structure creates good resistance to erosion. For example, forest serves as a temporary water storage. Although fine sand, silty and loamy soil has good resistance, other soils have a poor resistance to erosion. Hence, a steep surface can increase the affects to erosion, obviously, because it increases speed, and destruction of the runoff and sediment. Therefore, root of the tree of the forest can help to anchor the soil and provide a support to prevent movement of soil. However, the erosion of soil apparently easier to occur due to urbanization of certain places. Trees are cleared away during deforestation in order to undergo development.

1.2 Problem Statement

Soil sedimentation from soil erosion is a serious problem that is currently affecting all the countries in the world. As a country having tropical climate, Malaysia always receives high amount of rainfall intensity especially during the monsoon season which normally happens from October to March. Furthermore, Kuantan which is the research area, is located at the east coast region of Malaysia, hence, sediment yield of the sub-basins of the river tend to be high during this period due to the reason that the area is highly affected by monsoon season where the amount of rainfall during October to March is very high.

Water in the form of rain will be the main cause which accelerates the soil erosion rate on the ground. When the human activities on forest land occurs, the removal of vegetative cover such as trees during deforestation will contribute to this event as the runoff will increased while the infiltration of water into the soil is lesser.

As is known, waterways comprise of drainage basin or watershed. This is the area of land where the precipitation of rain that falls within it will drain through the drainage basin before escaping into rivers, lakes, oceans and seas. When heavy rain occurs, the rain will wash away the topsoil and bring along the sediments and soil to the river basin due to the human activities near the river basin such as over cropping, overgrazing and deforestation. Therefore, there is a need to study the soil erosion near the Kuantan river basin which undoubtedly causes flooding as the sediments and soil that deposits in the river bed which in turn causes the river to be unable to cope with large volume of runoff during heavy rain.

1.3 Objectives of Study

The aim of this study is to estimate the sediment yield of Kuantan river basin. To achieve this, the main specific objectives are outlined as follows:

i) Assessment of sediment yield for each sub-basin of the Kuantan river basin using the MUSLE.

ii) Comparison of the sediment yield from each sub-basins between year 2015 and 2035.

1.4 Scope of Study

This study estimates the sediment yield using all the parameters of the MUSLE mathematical model equation on the Kuantan sub-river basin. A series of data will be collected with regards to the parameters of runoff volume (V), peak discharge (Q_p), soil erodibility factor (K), slope length and steepness factor (LS), support practice factor (P) and erosion management factor (C). Other than that, ArcGIS software is also used to determine the sampling location and to analyses area of different land use and land cover. The land use and land cover will be used to determine cover management Factor, C and erosion control practice factor, P. Then, with all the relevant data, the sediment yield from Kuantan river basin will be computed using the MUSLE mathematical model equation.

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